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The purpose of this study was to examine Womack Army Medical Center's registered nurse staffing variances between the actual staffing levels and the recommended staffing levels for seven of its inpatient wards. This study considered five possible rationales for the existing variances – workload changes, staff experience, observation patients, recovery patients, and outpatient procedures – for 117 work shifts over a 39-day period. The primary source of data was the 24-Hour Nursing Reports. The registered nurse experience level yielded significance in four of the five accepted regression models. The workload changes and the recovery patients variables each yielded significance in separate models.

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Army-Baylor Graduate Program in Health and Business Administration

Graduate Management Project:
The Variance between Recommended and Nursing Staff Levels at Womack Army Medical Center

Presented to MAJ Lee W. Bewley, Ph.D.

In partial fulfillment of the requirements for
HCA 5661, Administrative Residency

By
MAJ Robert Holcek

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Abstract

The purpose of this study was to examine Womack Army Medical Center's registered nurse staffing variances between the actual staffing levels and the recommended staffing levels for seven of its inpatient wards. This study considered five possible rationales for the existing variances – workload changes, staff experience, observation patients, recovery patients, and outpatient procedures – for 117 work shifts over a 39-day period. The primary source of data was the 24-Hour Nursing Reports. The registered nurse experience level yielded significance in four of the five accepted regression models. The workload changes and the recovery patients variables each yielded significance in separate models.

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Introduction

Womack Army Medical Center (WAMC) is a 129-bed medical center located on Fort Bragg, North Carolina and provides medical services to over 180,000 beneficiaries. One medical service WAMC offers those beneficiaries is its ability to provide inpatient care. To render inpatient care, WAMC relies heavily on its inpatient nursing staff. The current inpatient nursing staff is able to accomplish its mission through its current staff strength. However, a disparity exists between the inpatient nursing staff strength and the recommended inpatient nursing staff strength. This study seeks to explain the staffing variances between the actual and recommended inpatient registered nurse staffing levels.

Fort Bragg, also known as "the center of the airborne universe," is home to the XVIII Airborne Corps, the 82nd Airborne Division, and the U.S. Army Special Operations Command. Adjacent to Fort Bragg is Pope Air Force Base. Historically, WAMC provides medical services to Fort Bragg, Pope Air Force Base, and Simmons Army Airfield; however, WAMC's task is not immutable. As a result of Base Realignment and Closure (BRAC)[1], the Army Transformation Plan[2], and the Army Campaign Plan[3], WAMC is currently modifying its service line to meet the needs of its changing beneficiary population. Between fiscal years 2006 and 2011, WAMC expects its beneficiary population to increase by over 19,000 beneficiaries due to BRAC, the Army Transformation Plan, and the Army Campaign Plan (Asadoorian, 2006; Fort Bragg, 2006).

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[1] BRAC is the process the Department of Defense uses to reorganize its installation infrastructure to better support its forces, increase readiness and generate new business plans (Department of Defense, 2006).

[2] The Army Transformation Plan is a long-term plan that calls for the Army to modify itself into a more rapidly deployable force capable of better executing its defense mission (General Accounting Office, 2001).

[3] In 2004, the Department of the Army initiated the Army Campaign Plan as a means of increasing mission capability. The ultimate objective was to redefine the Army's culture via multiple changes such as improving the wartime decision-making process, incorporating warrior ethos, and revising European/Pacific basing. Further more, the objective was to transform divisions into standardized brigade-size units that were smaller than divisions, yet were larger than a traditional brigade (Army Campaign Plan, 2006).

Approximately 28% of WAMC's beneficiary population are active duty[4], 33% are retired, and 38% are active duty family members. WAMC offers its beneficiaries a vast array of services ranging from primary care to bariatric surgery and vascular surgery to intensive care including neonatal intensive care. During a usual workday, WAMC fills over 4,000 prescriptions, performs over 2,700 pathology procedures, issues over 2,500 items of supply, and performs over 700 radiological procedures. WAMC also averages 94 inpatients, 30 admissions, 21 surgeries, and 9 births during that same workday (WAMC, 2006a).

In the local community, referred to as the Cape Fear region, there are four other hospitals – Cape Fear Valley Medical Center, a 426-bed facility; FirstHealth Moore Regional Hospital, a 385-bed facility; Fayetteville Veterans Affairs Medical Center, a 120-bed facility; and Highsmith-Rainey Memorial Hospital, a 112-bed facility. Even though WAMC is afforded the opportunity of employing military nurses, WAMC still has to compete with all of these hospitals for civilian nurses. Maintaining a competent civilian nursing staff has become a challenging mission for WAMC especially in a geographical area of great nursing demand coupled with a persistent national nursing shortage (Cape Fear Valley Health System, 2006a, 2006b; Department of Veterans Affairs, 2006; Erlen, 2004; FirstHealth, 2006).

Conditions that Prompted the Study

Before WAMC can sufficiently meet the staffing requirements created as a result of BRAC, the Army Transformation Plan, and the Army Campaign Plan; WAMC must first satisfactorily staff the hospital for its current workload. Just as Asadoorian (2006) focused on the primary care mission for WAMC with her study titled "A Requirements Analysis for Primary Care at Womack Army Medical Center," this study focuses on the inpatient nursing mission for

[4] Ft. Bragg's 50,679 soldiers represent the largest troop strength assigned to an Army installation (Asadoorian, 2006; WAMC, 2006a).

WAMC. Currently, the data generated regarding WAMC's inpatient nursing mission reveals that WAMC is adequately staffed to meet its existing inpatient workload.

First, as seen in Table 1, WAMC employs more nurses than both the Automated Staffing Assessment Model[5] III (ASAM III) and the Table of Distribution and Allowances[6] (TDA) recommend. Further, when WAMC's nursing staff for each inpatient section is analyzed per section as seen in Table 2, the data again demonstrate that WAMC employs more inpatient nurses than are suggested by the Workload Management System for Nurses[7] (WMSN). Given the data from these models, WAMC appears to be overstaffed with nurses.

Table 1

WAMC's Department of Nursing Authorizations

Fiscal year	ASAM III	TDA	WAMC
2006	406	335	445

Note. Adapted from "Womack Army Medical Center review and analysis 3rd quarter FY06," by WAMC, 2006b.

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[5] ASAM is used to determine the minimum staffing requirements for Army Medical Treatment Facilities. The ASAM uses mathematical formulas to determine the staffing for a specific mission or task based on the beneficiary population or projected workload. The ASAM is progressing to a population-based model (Manpower Requirements Branch, 2004).

[6] The TDA establishes the minimum civilian and military manpower requirements needed to allow for the most efficient and effective organization able to accomplish the organization's mission (Department of the Army, 2006).

[7] The WMSN is a patient classification system that "is designed to capture an estimate of what nursing time will be required to provide nursing care to a group of patients on a nursing unit" (WMSN, n.d., p. 3).

Table 2

WAMC's Nursing Staff per Inpatient Section

Section	WAMC	WMSN	Difference
Intensive care unit	21.1	21.2	(0.1)
Surgical ward	28.7	27.8	0.9
Medical ward	37.5	31.3	6.2
Psychiatric ward	15.3	12.0	3.3
Pediatric ward	13.8	12.0	1.8
Mother baby unit	35.6	41.1	(5.5)
Neonatal intensive care unit	27.6	20.6	7.0
Total	179.7	166.0	13.7

Note. 3rd quarter FY06. Adapted from "Womack Army Medical Center review and analysis 3rd quarter FY06," by WAMC, 2006b.

Despite the data, Colonel Joan Campanaro, WAMC's Deputy Commander for Patient Services[8], believes differently. She (personal communication, September 20, 2006) recently stated, ". . . our data indicates our acuities are lower than the norm and we are either overstaffed or right where we need to be in most areas. When I walk around, I know intuitively that this is not the case." Colonel Campanaro's intuition is based on her 27 years of nursing experience in the military. If Colonel Campanaro's observation is correct, then a potential challenge arises for WAMC's Department of Nursing in meeting its mission, "Provide quality patient care, comprehensive nursing care and customer service, to our beneficiaries" (WAMC, n.d.b).

[8] This title is bestowed upon the person serving as the senior nurse leader at WAMC.

The WMSN data is also suspect due to the age of WMSN. Since WMSN was first implemented in 1985, the field of nursing has undergone multiple advances that WMSN may fail to capture as workload. Beglinger (2006) stated, "Over the course of the past decade, the intensity of patient care requirements has increased . . ." (p. 193). Further, the WMSN manual states, ". . . the strength of WMSN is knowing its capabilities and limitations" (WMSN, n.d., p. 2). The WMSN manual even further acknowledges that the system fails to capture work performed by nurses by stating that throughout the provision of care, unexpected nursing care activities arise that are not captured by WMSN.

Further complicating the issue, the method of funding for Military Treatment Facilities (MTF) is rapidly changing from a historical approach to a performance-based approach, titled the Performance Based Adjustment Model or PBAM. This transition calls for the creation of performance measures along with a tracking method for which resources are to be allocated. As a result, instead of budgets being based solely on prior year's workload plus an inflation factor, an MTF's budget now considers a target production measurement per full time equivalent provider in the outpatient setting and a target average length of stay (ALOS) measurement for the inpatient setting (TRICARE Management Activity, 2006).

The transition to the performance based budget affects the inpatient nursing arena by the amount of funding that is allocated for nursing staff. By having the ALOS as the critical measurement that drives the performance based inpatient budget, one would intuitively believe that a decreased stay by a patient equates to less workload for nurses; however, that is not the case. As noted by Beglinger (2006), "the intensity of patient care requirements has increased because of . . . increasingly complex care requirements and declining length of stay" (p. 1).

Thus, maintaining a favorable measurement that promotes funding for the inpatient budget also equates to an increased demand on the nursing workload.

Problem Statement

The problem that arises for WAMC from a potentially diminished nursing staff is a failure for WAMC to deliver quality care to its patients and families. Not only would a failure to provide quality care violate WAMC's Department of Nursing mission, but it would also violate WAMC's mission, "Provide the highest quality health care, maximize the medical deployability of the force, ensure the readiness of Womack personnel, and sustain exceptional education and training programs" (WAMC, n.d.a).

The provision of quality care is better understood when conceptualized utilizing Donabedian's[9] theory for quality health care. Donabedian's theory for quality care utilizes three elements – structure, process, and outcome – in the provision of quality health care. Kelly-Heidenthal (2003) stated that the "structure elements consist of such things as a well-constructed hospital, quality patient care standards, quality staffing policies, environmental standards, and the like" (p. 18). Ransom, Joshi, and Nash (2005) further stated that when focusing on the structure element, the primary emphasis is directed at the characteristics of the staff and facility. Some staff characteristics include their education and training level, their experience level, and the adequacy of staff.

The process element spotlights the health care interventions utilized during the delivery of quality health care. These elements include managing the health care process along with implementing nursing standards and medical interventions such as clinical practice guidelines.

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[9] Avedis Donabedian was a physician and distinguished professor often referred to as the "father of quality assurance." His contributions to health care quality included access to health care along with measuring and evaluating health care quality. As a result of his many efforts, he was often the recipient of prestigious awards (Best & Neuhauser, 2004).

Additionally, the process element must be distinguished according to the appropriateness and skill level of the medical intervention. This distinction allows for a complete assessment of the process element by capturing that not only was the intervention indicated, but that the intervention was also expertly performed (Kelly-Heidenthal, 2003; Ransom et al., 2005).

The outcome element reflects upon the previous two elements, structure and process, in that it reveals the patient's outcome following the delivery of health care via the two initial elements. Ransom et al. (2005) exhibit the relationship among the three elements – structure (S), process (P), and outcome (O) – as "S + P = O" (p. 96). Even though the outcome element seeks to identify whether the healthcare objectives were achieved, Kelly-Heidenthal (2003) stated that "For quality to occur, monitors of all three elements of Donabedian's framework – structure, process, and outcome – should be in place" (p.18).

While monitors of all three elements of Donabedian's framework should exist, this study seeks to examine the structure element concerning WAMC's inpatient nursing sections as seen in *Figure Q1*. The structure portion analyzed by this study focuses on the variance between the actual inpatient nursing staff levels versus the WMSN recommended nursing staff levels. If WAMC is to fulfill its mission, then its structures should be of the utmost quality.

Literature Review

The American Nurses Association[10] (ANA) (2005) states that "adequate nurse staffing is critical to the delivering of quality patient care" (p. 20). The complexity inherent in this statement is derived from multiple factors including an organization's mission, budget constraints, and the shortage of nurses within the U.S.; thus, the need to determine adequate

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[10] The ANA is a professional organization that represents registered nurses. The ANA fosters the advancement of the nursing profession by promoting high standards of nursing practice, promoting the welfare of nurses in the workplace, and by lobbying Congress concerning health care issues (ANA, 2006).

nursing staff emerges. As a guide for determining adequate nursing staff, the ANA provides three major principles – patient care unit related, staff related, and organization related.

The ANA's (2005) patient care unit related principle recommends that staffing levels should reflect an analysis of the needs of both the individual patient and the collective sum of patients on the unit. In addition, the various other indirect patient care functions of the unit should be considered such as performance improvement initiatives and patient outcome evaluations. The WMSN specifically seeks to accomplish this principle in that it is designed "to capture an estimate of what nursing time will be required to provide nursing care to a group of patients on a nursing unit" (WMSN, n.d., p. 3). Moreover, the WMSN also allots for various indirect nursing care through its embedded formulas. Specifically, the WMSN manual lists some indirect nursing care as coordinating appointments, shift change reports, performance improvement initiatives, documenting, and computer operations.

The ANA's (2005) staff related principle states that the competency of the nursing staff must be sufficient to meet the health care needs of the patients and that less experienced nurses should have access to seasoned nurses for support. This ties in closely with the professional experience factor that WMSN lists as a potential rationale for the variance between its staffing recommendations and actual staffing levels. The WMSN was designed based on a broad continuum of experienced nurses in that it allots differing time intervals for task performance by novel nurses as compared to veteran nurses. The WMSN does so because it states, ". . . personnel involved in the delivery of heath care increase their overall speed and efficiency through continuous work experience" (WMSN, n.d., p. 7).

The organization related principle addresses the need for organizational policies that value all employees as strategic assets along with policies that identify the needs of patients and

nurses. The WMSN manual recognizes that it may not capture all workload; therefore, its recommendations may not allot for adequate nursing personnel to meet patients' needs. Consequently, the WMSN manual states that its staffing estimate should only be a projection that nursing managers use as a precursor in determining actual staffing requirements (ANA, 2005; WMSN, n.d.).

The ideal staffing plan provides the appropriate mixture of nurses for patients based on data that predicts the patient census. Management within an organization determines the organization's staffing plan. Grohar-Murray and DiCroce (2003) provide four phases for management to follow in determining a staffing plan. In phase one, management must identify the organization's statement of purpose, services rendered, and standards of care. In phase two, management specifies a means of determining the amount and type of staff needed. In phase three, management develops assignment patterns utilizing policies and guidelines. Finally, in phase four, management evaluates the staffing plan using patient outcome data, quality metrics, and other data such as staff turnover and attrition. A rational for the variance between the WMSN recommended nursing staff and the actual nursing staff should assist management in utilizing Grohar-Murray and DiCroce's four phases of determining a nursing staffing plan.

Kelly-Heidenthal (2003) provides examples of performance metrics for the staffing structure such as the percent of physicians that are board certified, hospital accreditation by the Joint Commission on Accreditation of Healthcare Organizations[11] (JCAHO), the ability to recruit registered nurses (RN), and the comparison of compensation packages with competitors. Similarly, Medicare and Medicaid regulations (as cited in Swansburg & Swansburg, 2002)

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[11] Operating since 1951 as an independent, not-for-profit organization, JCAHO is the primary standards-setting and accrediting body in health care within the U.S. JCAHO evaluates organizations for their provision of quality care through its comprehensive accreditation process. A hospital's accreditation by JCAHO is recognized nationwide as a symbol of its quality health care (JCAHO 2006).

identify one of its hospital standards as maintaining a chain of command within the hospital's department of nursing. At the apex of that chain of command is the director of nursing who is responsible for determining the amount and type of nursing staff required to provide patient care.

Finally, nurse-patient ratios have emerged as one of the more frequently discussed topics regarding staffing structures. These discussions stemmed from California legislation signed in 1999 that initially required mandatory hospital nurse staffing levels and prescribed ratios of registered nurses to nonprofessional nursing personnel. Currently, California's mandated nurse to patient ratios in effect as of July 2003 are summarized in Table 3. The WMSN recommended ratios are presented in Table 4. Whereas California determines its ratios according to the number of patients per particular ward, the WMSN recommended ratios are determined utilizing a current snapshot of the estimated nursing care hours required for the existing patient population. As a result of California's mandated ratios, several audiences affected by the ratios voiced mixed emotions. Those emotions ranged from the occasional praise to fear that the ratios will become the maximum staffing ratios versus the minimum staffing ratios (Almeida, 2002; ANA, 2005; Buerhaus & Needleman, 2000; Clarke & Aiken, 2003; Doolan, 2005; JCAHO, 2002; Roman, 2005; Spetz, 2004a, 2004b; White, 2006).

Table 3

California Staffing Ratios

Determinant	Nurse to patient ratio
Medical / surgical ward	1:6
Pediatric ward	1:4
Obstetrics	1:2
Emergency department	1:4
Intensive care	1:2

Note. The California determinant equals the type of inpatient ward. Adapted from *Health care at the crossroads: Strategies for addressing the evolving nursing crisis* by the JCAHO, 2002, p. 20.

Table 4

WMSN Staffing Ratios

Determinant	Nurse to patient ratio
1	1:20
4	1:6
10	1:3
17	1:2
25	1:1
>30	>1:1

Note. The WMSN determinant equals the approximate daily nursing care hours required to render care to the patients. WMSN, n.d., p. 25.

Grohar-Murray and DiCroce (2003) also define workload as being "determined through an assessment of the patients' severity and an estimate of the indirect and unit-based work

requirements" (p. 278). Thus, workload is a function of both the amount of patients on a unit and a measure of the work required to render care for those patients. Measuring that workload is traditionally accomplished using a patient classification system such as WMSN for the Army. The patient classification system allows for documentation of patient severity along with the requirements of care. After estimating both the direct and indirect care requirements for the patient mix and inputting that information into the system, the system then provides a staffing plan required to care for the respective patient mix (Department of the Army, 1990; Kelly-Heidenthal, 2003).

Purpose

The purpose of this study is to explore the integrity of WAMC's data and the data processes utilized by Army MTFs in identifying the RN staff level requirements for inpatient wards. As a result, this study will explore possible rationales for the existing variances between the actual RN staff levels and the WMSN recommended RN staff levels. This study intends to evaluate current business practices and data quality concerns.

Methods

Experimental Design

This study follows an explanatory model in that it seeks to identify the root cause of the variance between the actual numbers of inpatient RN staff and the WMSN recommended inpatient RN staff. The focus is to improve the accuracy of determining the number RN staff for the inpatient wards. The dependent variable in this study is the presence of an RN staffing variance in each of WAMC's inpatient nursing sections. The independent variables are changes in workload, the presence of a difference in staff mix recommendations, the RN staff's experience, the number of observation patients, the presence of more than one type of patient on

the nursing unit, the number of recovery patients, and the number of outpatient procedures. Appendix A contains more detailed variable definitions. The research process is displayed in *Figure Q2*.

The seven inpatient nursing areas to be studied will each be assigned a dummy dependent variable of one for an RN variance of at least plus or minus two; otherwise, the dependent variable will be zero. The RN variance will then be examined against the independent variables for correlations. Thus, the experimental design represented in statistical notation is as follows: $O_1O_2O_3$. The first observation of the data, represented by O_1, is the raw data obtained from retrieval. This secondary data will be collected from various sources representing a 39-day period, 21 January through 28 February 2007. Appendix B lists the various data sources to be utilized. The second observation, represented by O_2, is the observation of the dependent variables for assignment as a one or a zero; and the O_3 represents the final observation of the data after applying statistical procedures.

Hypotheses

The null hypothesis for this study is represented by $b1 = b2 = b3 = b4 = b5 = b6 = b7 = b8$ in that there would be no difference between the dependent variable and the independent variables. If this were true, then those variables would possess tautology. The alternate hypothesis for this study is represented by $b1 \neq b2 \neq b3 \neq b4 \neq b5 \neq b6 \neq b7 \neq b8$ in that the dependent variable is different from the independent variables; thus no tautology. The hypothesis statements for this study are presented in Appendix C.

The alpha probabilities for this study are set at the $p < .05$ level and all statistical analyses will be conducted utilizing Minitab 15. Thus, when comparing the dependent variable and the independent variables, a $p < .05$ signifies that there is a statistical difference between the

dependent variable and the independent variables greater than 95% of the time. Given this finding, the null hypothesis would be rejected and the alternate hypothesis would be accepted.

Methodology

Since the dependent variable is the presence of an RN staffing variance in each of WAMC's inpatient nursing sections, it is by default a binary variable. By having a binary dependent variable, the effects of the independent variables upon the dependent variable have to be determined using logistic regression. Logistic regression is a non-parametric test and lacks the robustness of a parametric test such as linear regression. Logistic regression is a non-parametric test because it utilizes data that are not normally distributive such as binary data. As logistic regression is not as robust of a test as a parametric test, this increases the risk of a Type I error, or falsely rejecting a null hypothesis. In addition, since two of the seven independent variables in this study are also binary, there was a failure to meet the assumptions of regression and an additional increased risk of a Type I error.

Logistic regression works by transforming the binary dependent variable into a nearly normally distributed variable. The first step in this transformation is the calculation of the odds for the binary variable. Following the odds calculation, logistic regression then takes the natural logarithm of the odds. By taking the natural logarithm of the odds, logistic regression transforms the binary data into a more nearly normal variable with a mean of zero.

A logistic regression equation is represented with the following equation:

$$\prod(x) = e^{\beta 0 + \beta 1(X1) + \beta 2(X2) + \beta 3(X3)} / 1 + e^{\beta 0 + \beta 1(X1) + \beta 2(X2) + \beta 3(X3)}.$$

In this equation, $\prod(x)$ represents the dependent variable and e represents the exponential function constant that equals approximately 2.72. The regression constant is represented by $\beta 0$, which is

also the *Y* intercept if all other variables are equal to zero. The estimator, β_n, is the partial regression coefficient or the slope associated with X_n, the identifier for the predictor variables. The following equation represents the logistic regression equation for this study:

$$\prod(x) = e^{\beta 0 + \beta 1(wkld) + \beta 2(smdiff) + \beta 3(RNexp) + \beta 4(obsvpt) + \beta 5(ptmix) + \beta 6(rcvery) + \beta 7(outptproc)} / 1 + e^{\beta 0 + \beta 1(wkld) + \beta 2(smdiff) + \beta 3(exp) + \beta 4(obsvpt) + \beta 5(ptmix) + \beta 6(rcvery) + \beta 7(outptproc)}.$$

The variables, the codes assigned to the variables, and data sources are located in Appendix B.

To test the predictive values of the independent variables against the dependent variable, Minitab utilizes both a *G* test and a z-test statistic. First, the *G* test, which tests to determine if all slopes are zero, is examined for significance. A significant *G* test indicates significance between at least one predictive variable and the dependent variable. An insignificant *G* test indicates no significance between the independent and dependent variables. The formula for the *G* test is as follows: $G = 2\sum_i O_i \cdot \ln(O_i / E_i)$. This formula takes the sum of all cells for which the O_i represents the observed, E_i represents the expected, and ln represents the natural logarithm.

Following identification of a significant *G* test, z-test results are then examined for significance. Each independent variable is compared to the dependent variable utilizing the z-test. Identification of a significant z-test indicates significance between the associated independent and dependent variable; otherwise, a significant predictor. One limitation of the z-test statistic is that it provides less accurate results when samples sizes are less than 30. The formula for the z-test statistic is as follows: z = coefficient / standard error of the coefficient.

Another useful statistic provided with logistic regression is the odds ratio. The odds ratio is a measure of association between the independent and dependent variables. An odds ratio less than one indicates an inverse or negative relationship between variables, an odds ratio equal to one identifies no association between variables, and an odds ratio greater than one signifies a

positive or direct relationship between variables. The further from one the odds ratio, the greater the relationship, either direct or indirect. Thus, an odds ratio of 0.75 that is less than one would indicate a 25% inverse relationship between variables while an odds ratio of 1.25 indicates a 25% direct relationship between variables (Vogt, 2005).

To test the fit of the overall model, Minitab uses a goodness-of-fit test that yields a deviance result. The deviance result tests the logistic regression model's null hypothesis that states the model fits the data; therefore, the desired result is an insignificant deviance result or a $p > .05$. If the model yields a significant deviance with a $p < .05$, then other models should be considered as potential exists for application of an enhanced statistical model (Cook, et al., 2007; Minitab Inc., 2007; Vogt, 2005).

Results

Data Collection

During data collection, it was noted that some of the original independent variables - changes in workload, the presence of a difference in staff mix recommendations, the RN staff's experience, the number of observation patients, and the presence of more than one type of patient on the nursing unit – planned for the regression models needed to be altered. First, not every ward cared for observation patients; therefore, the number of observation patients as an independent variable was included only in the models for the wards that tended to observation patients – the surgical ward, the medical ward, and the pediatric ward.

Although no data was available for observation patients in the intensive care unit (ICU), the ICU did recover patients postoperatively when the post anesthesia care unit was closed. In effect, recovering patients is comparable to tending to an observation patient in that the nursing care hours spent recovering the patients cannot be counted in WMSN because the patients were

only recovered in the ICU and not admitted to the ICU. Therefore, the number of recoveries as an independent variable was added to the ICU regression model.

The same rationale for including recoveries as an independent variable in the ICU regression model lent itself to including outpatient procedures as an independent variable in the pediatric ward regression model. Periodically, the pediatric ward performs various outpatient procedures such as administration of intravenous medications to pediatric patients during the off-duty hours of the pediatric clinic. Again, since these patients are not admitted to the pediatric ward, the nursing care hours performed in tending to these patients is not counted in WMSN; hence, the inclusion of outpatient procedures as an independent variable in the pediatric regression model.

Two of the independent variables – the presence of a difference in staff mix recommendations and the presence of more than one type of patient on the nursing unit – were eliminated from the study. The presence of a difference in staff mix recommendations was excluded due to after recoding into a dummy variable, the majority, 782 out of 819 or 95%, of all recoded variables was one or yes which indicated presence of a difference. Having a variable without much disparity within the variable failed to offer any value to the regression model. The presence of more than one type of patient on the nursing units was omitted as a variable because no data was available for that variable. Further, in speaking with the head nurses of each unit, the consensus was that their wards cared for the appropriate patient types.

Finally, two methods were utilized for missing data. The first method was to utilize multiple data sources in an effort to reconcile data. For instance, if the nursing care hours were available on the 24-Hour Nursing Reports yet the corresponding recommended numbers of staff were missing, then the recommended numbers of staff were obtained via the appropriate nursing

care hour tables. Likewise, if the actual numbers of working staff members were missing from the 24-Hour Nursing Reports, then the corresponding ward's work schedules were utilized. The second method utilized for missing data was to use averages. Thus, if a census was given for a ward on the 24-Hour Nursing Report and no corresponding nursing care hours were listed, then the average nursing care hours for corresponding shifts with identical censuses were utilized as the missing datum.

Sample Size

Prior to data collection, a power analysis was conducted to determine a sample size representative of the population. With alpha probabilities for this study set at the $p < .05$, an effect size of .3, and a sample size of 117; the resulting power was .86, which is greater than the decision criteria of .80. Therefore, a sample size of 117 for this study is sufficiently representative of the population. By ensuring an adequate power prior to data collection and analysis, the probability of a Type II error, falsely accepting a null hypothesis, was decreased (Vogt, 2005).

Descriptive Statistics

The first variable analyzed was the proportion of RN staffing variances per ward for the 117 shifts studied. As seen in Appendix D, the ward that experienced the most variances was the surgical ward with 75 shifts, 64%, that had a difference of either plus or minus 2 RNs compared to the WMSN recommendation. The psychiatric and pediatric wards experienced the fewest number of shift variances at 9 and 12 or 8% and 10% respectively. The remainder of the wards and the entire hospital all experienced variances approximately 40% of the time.

Despite presenting RN staffing variances of plus or minus two, Appendix D fails to present the magnitude and direction of the variance. To determine if the ward was overstaffed or

understaffed, the total RN staffing variances were computed and presented in Appendix E. Not only did the surgical ward experience the greatest amount of staffing variances, but its variance was 247 more RNs than recommended for the 117 shifts. At the opposite end of the spectrum, the neonatal intensive care unit (NICU) operated with 111.5 fewer RNs than was recommended for the observed period.

For an even greater detailed appreciation of the staffing variances, Appendix F presents the total staffing variances for each work shift per ward. The trend for most wards is for more RNs than recommended during the day shift with a gradual movement toward the recommended number of RNs by the night shift. When viewing the by shift detail, the NICU was not the only ward to operate with fewer RNs than recommended. The ICU also operated with fewer than the recommended number of RNs during its nightshift.

The descriptive statistics for the workload and RN experience variables are presented in Appendix G. The workload trend steadily decreased from day shift to night shift for each ward except for the pediatric ward, which experienced a slight increase in workload from the day shift to its evening shift. However, the pediatric ward's workload drastically decreased from the evening shift to its night shift.

The range of the number of years of nursing experience for each ward's RN staff is presented in Appendix H. The ICU, the NICU, and the psychiatric ward maintain RN staffs whose least experienced RN has the greatest number of years nursing – 6 years, 3 years, and 6 years respectively. The mother baby unit and the medical ward both have the RN staffs with the lowest average number of years nursing experience. Although the pediatric ward has the RN staff with the highest average number of years nursing experience, this average is skewed because of the small staff size, 7 RNs, and the presence of the most seasoned nurse, 50 years

experience. Finally, the descriptive statistics for the observation patients, the recovery patients, and the outpatient procedures variables are presented in Appendix I.

Regression Models

Surgical ward.

The independent variables included in the surgical ward regression model were workload, RN experience, and observation patients as seen in Appendix J. The *G* test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variable within this model was the RN experience variable with a $z = 2.14$, $p < .05$. The remaining two independent variables failed to meet the significance parameter for this study of $p < .05$. The overall surgical ward regression model also failed to yield significance with a deviance (110, $n = 117$) = 135.45, $p = .05$; therefore, this model possesses a goodness-of-fit for the surgical ward. From these results, it can be concluded that the RN experience variable is a significant predictor of an RN staffing variance for the surgical ward, and the resulting regression equation is as follows:

$$\prod(x) = e^{-0.76 + 0.09(\text{wkld}) + 0.02(\text{RNexp}) - 0.12(\text{obsvpt})} / 1 + e^{-0.76 + 0.09(\text{wkld}) + 0.02(\text{RNexp}) - 0.12(\text{obsvpt})}.$$

Furthermore, the odds ratio for the surgical ward RN experience variable was 1.02 indicating a 2% likelihood that a one-unit increase in RN experience on the surgical ward results in a one-unit increase in staffing variance.

Mother baby unit.

The independent variables included in the mother baby unit regression model were workload and RN experience as seen in Appendix K. The *G* test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variable within this model was the RN experience variable with a $z = 4.23$, $p < .05$.

The workload variable failed to meet the significance parameter for this study. The overall mother baby unit regression model also failed to yield significance with a deviance (111, n = 117) = 126.62, $p > .05$; therefore, this model possesses a goodness-of-fit for the mother baby unit. From these results, it can be concluded that the RN experience variable is a significant predictor of an RN staffing variance for the mother baby unit, and the resulting regression equation is as follows:

$$\prod(x) = e^{-1.67 - 0.04(\text{wkld}) + 0.04(\text{RNexp})} / 1 + e^{-1.67 - 0.04(\text{wkld}) + 0.04(\text{RNexp})}.$$

The RN experience odds ratio for the mother baby unit was 1.05 indicating a 5% likelihood that a one-unit increase in RN experience on the mother baby results in a corresponding one-unit increase in the staffing variance for that unit.

Medical ward.

The independent variables included in the medical ward regression model were workload, RN experience, and observation patients as seen in Appendix L. The G test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variables within this model were workload with a z = – 2.99, $p < .05$ and the RN experience variable with a z = 2.51, $p < .05$. The remaining independent variable, observation patients, failed to meet the significance parameter for this study. The overall medical ward regression model yielded significance with a deviance (96, n = 117) = 124.22, $p < .05$; therefore, this model failed to possess a goodness-of-fit for the medical ward and the potential exists for a better statistical models. Nonetheless, it can still be concluded that workload and the RN experience variables are significant predictors of an RN staffing variance for the medical ward.

Additionally, the workload odds ratio for the medical ward was 0.81 indicating a 19% likelihood that a one-unit increase in workload on the medical ward results in a corresponding one-unit decrease in the staffing variance for that unit; thus, a negative or inverse relationship between the variables. This inverse relationship is also evident in the negative workload variable coefficient. However, the RN experience variable displayed a positive association with staffing variance with an odds ratio of 1.06. This odds ratio indicates a 6% likelihood that a one-unit increase in RN experience results in a corresponding one-unit increase in the staffing variance for the medical ward.

Psychiatric ward.

The independent variables included in the psychiatric ward regression model were workload and RN experience as seen in Appendix M. The *G* test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variable within this model was the RN experience variable with a $z = 3.82$, $p < .05$. The remaining independent variable, workload, failed to meet the significance parameter for this study of $p < .05$. The overall psychiatric ward regression model also failed to yield significance with a deviance $(65, n = 117) = 40.37$, $p > .05$; therefore, this model possesses a goodness-of-fit for the psychiatric ward. From these results, it can be concluded that the RN experience variable is a significant predictor of an RN staffing variance for the psychiatric ward, and the resulting regression equation is as follows:

$\prod(x) = e^{-6.17 + 0.35(\text{wkld}) + 0.08(\text{RNexp})} / 1 + e^{-6.17 + 0.35(\text{wkld}) + 0.08(\text{RNexp})}$.

The psychiatric ward's odds ratio for its RN experience variable was 1.08 signifying an 8% likelihood exists that a one-unit increase in that unit's RN experience also results in a one-unit increase in its staffing variance.

Intensive care unit.

The independent variables included in the ICU regression model were workload, RN experience, and recovery patients as seen in Appendix N. The *G* test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variables within this model were RN experience with a $z = 4.53$, $p < .05$ and the recovery patient variable with a $z = -2.08$, $p < .05$. The remaining independent variable, workload, did not posses a significant relationship. The overall ICU regression model also failed to yield significance with a deviance (96, $n = 117$) = 105.20, $p > .05$; therefore, this model possesses a goodness-of-fit for the ICU. From these results, it can be concluded that the variables of RN experience and recovery patients are significant predictors of an RN staffing variance for the ICU, and the resulting regression equation is as follows:

$$\prod(x) = e^{-1.67 + 0.01(\text{wkld}) + 0.03(\text{RNexp}) - 0.54(\text{rcvery})} / 1 + e^{-1.67 + 0.01(\text{wkld}) + 0.03(\text{RNexp}) - 0.54(\text{rcvery})}.$$

For the ICU, its RN experience variable displayed a positive association with staffing variance with an odds ratio of 1.03. This odds ratio indicates a 3% likelihood that a one-unit increase in RN experience results in a corresponding one-unit increase in the staffing variance for the ICU. However, its recovery patients' odds ratio was 0.58 indicating a 42% likelihood that a one-unit increase in recovery patients for the ICU results in a corresponding one-unit decrease in the staffing variance; thus, an inverse relationship between the variables. Again, this inverse relationship is also evident in the negative recovery variable coefficient.

Neonatal intensive care unit.

The independent variables included in the NICU regression model were workload and RN experience as seen in Appendix O. The *G* test for this model failed to yield significance with a $p > .05$; thus, there were no significant predictor variables. Furthermore, the overall NICU

regression model yielded significance with a deviance (89, $n = 117$) = 118.65, $p < .05$; therefore, this model also failed to possess a goodness-of-fit for the NICU and the potential exists for a better statistical model. From these results, no variables can be utilized for the NICU as a predictor of an RN staffing variance.

Pediatric ward.

The independent variables included in the psychiatric ward regression model were workload, RN experience, observation patients, and outpatient procedures as seen in Appendix P. The G test for this model yielded significance with a $p < .05$; thus, there was at least one significant predictor. The significant predictor variable within this model was the workload variable with a $z = 3.37$, $p < .05$. The remaining three independent variables did not meet the significance parameter for this study. The overall pediatric ward regression model also failed to yield significance with a deviance (71, $n = 117$) = 53.77, $p > .05$; therefore, this model possesses a goodness-of-fit for the pediatric ward. From these results, it can be concluded that the workload variable is a significant predictor of an RN staffing variance for the pediatric ward, and the resulting regression equation is as follows:

$$\prod(x) = e^{-4.89 + 0.74(\text{wkld}) + 0.04(\text{RNexp}) - 0.70(\text{obsvpt}) + 0.07(\text{outptproc})} / 1 + e^{-4.89 + 0.74(\text{wkld}) + 0.04(\text{RNexp}) - 0.70(\text{obsvpt}) + 0.07(\text{outptproc})}.$$

The workload odds ratio for the pediatric ward displayed the greatest amount of distance from one out of all odds ratios at 2.10. This odds ratio suggests a 110% likelihood that a one-unit increase in workload on the pediatric ward results in a corresponding one-unit increase in the staffing variance for that ward.

Limitations and Assumptions

This study was not without limitations. Primarily, non-parametric tests such as logistic regression lack in robustness as is evident with parametric tests. This is because non-parametric tests allow for the analysis of binary variables that are not normally distributive. This weakness inherent with logistic regression increases the risk of falsely rejecting the null hypothesis when it is true thereby weakening the validity of the study.

Another limitation of this study was the limited timeframe of the study. By only analyzing data for a 39-day period, the corresponding patient census during that time may not be representative of WAMC's normal patient census. Hospital censuses rise and fall for various reasons such as seasonal fluctuations. Consequently, either a low census or a high census resulting from a potential seasonal fluctuation may have swayed the staffing variances (Schmidt & Nelson, 1996).

One assumption within this study is that the reported numbers of staff working on the 24-Hour Nursing Reports are a true capture of the actual staff. The actual numbers of staff could be less than or more than what is reported which weakens the study. Another assumption is that nursing experience is positively correlated with work efficiency; therefore, indicating that fewer seasonal nurses are required to perform the same tasks as less seasoned nurses. A third assumption is that WMSN has failed to maintain pace with the nursing profession; as a result, the system fails to provide accurate staffing recommendations based on today's nursing tasks.

Conclusion

The purpose of this study was to explore the integrity of WAMC's data and the data processes utilized by Army MTFs in identifying the RN staff level requirements for inpatient wards. To do so, this study explored possible rationales for the existing variances between the

actual RN staff levels and the WMSN recommended RN staff levels in an attempt to evaluate current business practices and data quality concerns.

The staffing system employed in Army MTFs is WMSN. Implemented in the early 1980s, WMSN has existed without significant advances while the nursing profession's standards of care have advanced over the years. Thus, WMSN may have outlived the ever-growing disparity between the nursing profession's standard of care requirements and its ability to measure those requirements in providing staffing recommendations. In an attempt to corroborate RN staffing variances, this study sought to utilize various explanations offered by WMSN such as RN experience, differences in staff mix, and patient mix as predictor variables of the RN staffing variances. For diverse reasons, the differences in staff mix and the patient mix variables were excluded from the study. However, changes in workload, recovery patients, observation patients, and outpatient procedures were included in the study as predictor variables.

Seven different wards were included in this study with each ward experiencing different levels of RN staffing variances during the timeframe of the study. The majority of the wards staffed RN levels greater than what was recommended by WMSN. The exception to this was the NICU, which was consistently understaffed throughout the studied timeframe. Although the ICU's total RN staffing was greater than recommended during the timeframe, its night shift was understaffed.

Of the seven regression models, the NICU model was excluded because it failed in both providing goodness-of-fit and significant predictors. Even though the medical ward model was excluded because the potential exists for a better model as indicated by its failure of meeting the goodness-of-fit parameter, it still yielded significance between RN experience and RN staffing variance. The same significance between RN experience and RN staffing also held true for all

other models utilized except for the pediatric regression model. The two other significant predictors were recovery in the ICU equation and workload in both the medical equation and the pediatric equation.

Since the coefficient for the recovery patient variable in the ICU regression equation was negative, it implied that the ICU staffing variance decreased as the recovery variable increased. The odds ratio suggests that there is a 42% likelihood of this occurring. This defies the logical reasoning of the more recoveries performed, the greater the staffing variance. Unfortunately, the recovery variable was unable to be assessed in other regression models since no other wards perform the recovery mission.

Although significant in two models, the workload variable also displayed a negative impact on the staffing variance in the medical equation, but it was positively correlated in the pediatric equation. Possibly, this is why the medical model did not meet the goodness-of-fit parameter. Nonetheless, it is without surprise that workload yielded positive significance in the pediatric regression equation. Furthermore, the odds ratio for the pediatric's workload variable displayed the greatest difference from one at 2.10, indicating a 110% likelihood that changes in workload result in increased staffing variances for the pediatric unit. On the other hand, the medical ward's workload odds ratio was 0.81 indicating a 19% likelihood that an increase in its workload decreases its staffing variance.

In effect, significance between workload and staffing variances suggests that as workload changes, if the numbers of staff do not change, then the potential exists for a staffing variance. It would be counterintuitive for that not to occur. This variance exists, because at any time, the potential exists for changes in workload – admissions, discharges, transfers in, or transfers out.

However, the most common time for the RN staffing numbers to change on a ward is at the change in shifts.

By having an experienced RN staff, the assumption is the staff is efficient; therefore, they are able to meet nursing standards of care with fewer than the recommended numbers of RNs as was suggested by WMSN. This study supports this claim via positive coefficients in all of the accepted regression equations. Furthermore, RN experience was found to be a significant predictor of RN staffing variance in all five of the accepted regression models. The odds ratios for these five regression models indicate anywhere from 2% in the surgical ward model to 8% in the psychiatric ward model exists the likelihood that increases in RN experience result in increases in staffing variances (WMSN, n.d.).

Recommendations

One recommendation for future studies would be to increase the timeframe of the study. Not only would this lend strength to the study through a greater sample size, but it would also aid in alleviating the limitation of seasonal census fluctuations. Such an addition would decrease any speculation as to why a ward might be chronically understaffed with RNs as was the case with the NICU in this study.

Another recommendation, if recoding the dependent variable into dummy variables, would be to utilize two dependent variables. One dependent variable would represent an overstaffed variance and the other dependent variable would represent an understaffed variance. However, if seeking to strengthen the study, the same study could be performed without any recoding of variables, rather the application of the actual staffing variances as the dependent variable. This would open the study to the application of a more robust statistical test.

Additional predictor variables could also be utilized. One potential predictor variable would be whether the RNs maintained a form of nursing certification. An example of nursing certification is certification as a Critical Care RN. Another potential predictor variable would be the RN's education level. Educational level differences for RNs include associate degrees, baccalaureate degrees, or master's degree.

The final recommendation is for more studies in this area to validate the findings of this study since economical principles such as the law of diminishing marginal productivity suggest limitations to the efficiencies associated with experience. The law of diminishing marginal product is defined according to Santerre and Neun (2004) as:

> An economic principle stating that as more and more units of an input are used in production, a point is eventually reached where output increases by a continually smaller and smaller amount. In other words, the marginal product of the factor begins to fall in value. (p. 561)

Therefore, experience may have its limitations in being efficient and future studies yielding similar results would lend validity to this study.

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Appendix A

Variable Definitions

Term	Definition
Staffing variance	Whether or not the measure of the difference between the actual inpatient RN staff and the WMSN recommended RN staff in a section on a daily basis by shift exceeded +/- two
Changes in workload	Indicates a patient admission, discharge, transfer in or transfer out
Differences between staff mix and recommended staff mix	Indicates a variance between the number of RNs, licensed practical nurses, and nursing assistants versus the WMSN recommended number of respective persons
Nursing staff's experience	The number of years an assigned RN has practicing as a nurse
Observation patients	The number of observation patients on a unit
Patient mix	Whether or not the section has patient types other than what the section is classified for in WMSN
Recovery	The number of post-operative recoveries performed by the Intensive Care Unit (ICU)
Outpatient procedure	The number of outpatient procedures scheduled and performed on a unit

Appendix B

Code Sheet

Variables and SPSS Variable Code	Description	SPSS Data Codes	Variable Type	Data Source
Dependent Variables				
Staffing variance surgical ward (svsurg)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance mother baby unit (svmom)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance medical ward (svmed)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance psychiatric ward (svpsych)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance ICU (svicu)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance neonatal ICU (svnicu)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Staffing variance pediatric ward (svpeds)	Variance between actual and WMSN RN staff level of at least +/- 2	1=yes 0=no	Binary	24-hour Nursing Report and Work Schedules
Independent Variables				
Changes in workload (wkld)	Indicates a patient admission, discharge, transfer in, or transfer out occurred	1=one wkld transaction 2=two wkld transactions 3=three wkld transactions etc…	Continuous	24-hour Nursing Report
Differences between staff mix and recommended staff mix (smdiff)	Indicates a variance between the number of RNs, licensed practical nurses, and nursing assistants versus the WMSN recommended number of respective persons	1=yes 0=no	Binary	24-hour Nursing Report and WMSN
Nursing staff's experience (RNexp)	The number of years an assigned RN has practicing as a nurse	1=one year or less 2=two 3=three etc…	Continuous	Manual

Variables and SPSS Variable Code	Description	SPSS Data Codes	Variable Type	Data Source
Independent Variables				
Observation patients (obsvpt)	The number of observation patients	1=one patient 2=two patients 3=three patients etc…	Continuous	24-hour Nursing Report and Surgery Staffing Schedule
Patient mix (ptmix)	Whether or not the section has patient types other than what the section is classified for in WMSN	1=yes 0=no	Binary	Manual
Recovery (rcvery)	The number of post-operative recoveries performed by the ICU	1=one recovery 2=two recoveries 3=three recoveries etc…	Continuous	24-hour Nursing Report
Outpatient procedure (outptproc)	The number of outpatient procedures scheduled and performed on a unit	1=one procedure 2=two procedures 3=three procedures etc…	Continuous	24-hour Nursing Report and manual

Appendix C

Formal Hypotheses

Code	Hypothesis
H_{a1}	Changes in workload do affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø1}$	Changes in workload do not affect the presence of an RN staffing variance between the actual and WMSN
H_{a2}	Differences in staff mix recommendations do affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø2}$	Differences in staff mix recommendations do not affect the presence of an RN staffing variance between the actual and WMSN
H_{a3}	The RN staff's experience does affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø3}$	The RN staff's experience does not affect the presence of an RN staffing variance between the actual and WMSN
H_{a4}	The number of observation patients does affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø4}$	The number of observation patients does not affect the presence of an RN staffing variance between the actual and WMSN
H_{a5}	The presence of more than one type of patient on a nursing unit does affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø5}$	The presence of more than one type of patient on a nursing unit does not affect the presence of an RN staffing variance between the actual and WMSN

Code	Hypothesis
H_{a6}	The number of recovery patients does affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø6}$	The number of recovery patients does not affect the presence of an RN staffing variance between the actual and WMSN
H_{a7}	The number of outpatient procedures does affect the presence of an RN staffing variance between the actual and WMSN
$H_{ø7}$	The number of outpatient procedures does not affect the presence of an RN staffing variance between the actual and WMSN

Appendix D

Frequency of Registered Nurse Staffing Variance

Unit	Variance	Frequency	Proportion
WAMC[a]	Yes	361	.44
	No	458	
Surg	Yes	75	.64
	No	42	
MBU	Yes	50	.43
	No	67	
Med	Yes	51	.44
	No	66	
Psych	Yes	9	.08
	No	108	
ICU	Yes	56	.48
	No	61	
NICU	Yes	48	.41
	No	69	
Peds	Yes	12	.10
	No	105	

Note. $n = 117$.

[a]The WAMC $n = 819$.

Appendix E

Descriptive Statistics for Unit Staffing Variances

Unit	Total[a]	*M*	*SD*
WAMC	620	5.30	3.64
Surg	247	2.11	1.52
MBU	142	1.21	1.62
Med	98	0.84	1.46
Psych	59	0.50	0.72
ICU	162	1.38	1.72
NICU	-111.5	-0.95	1.58
Peds	23	0.20	0.86

Note. $n = 117$ for all variables. Three shifts – day, evening, and night – per day for 39 consecutives days, 21 January through 28 February 2007, were analyzed.

[a]The total equals the total variance between the WMSN recommended number of RNs and the number of RNs that worked during the analyzed timeframe.

Appendix F

Descriptive Statistics for Work Shift Staffing Variances

Unit shift	Total[a]	*M*	*SD*
Surg			
Day	121	3.10	1.60
Evening	45	1.15	1.31
Night	81	2.08	0.93
MBU			
Day	46.5	1.19	2.18
Evening	33.5	0.86	1.24
Night	58	1.49	1.25
Med			
Day	2.5	0.06	1.54
Evening	19	0.49	1.97
Night	77	1.97	0.54
Psych			
Day	34	0.87	0.89
Evening	19	0.49	0.62
Night	6	0.15	0.37

Unit shift	Total[a]	*M*	*SD*
ICU			
Day	105	2.69	149.00
Evening	61	1.56	1.03
Night	-5	-0.13	1.26
NICU			
Day	-25	-0.64	1.58
Evening	-56.5	-1.45	1.41
Night	-30	-0.77	1.65
Peds			
Day	10	0.26	1.19
Evening	11	0.28	0.83
Night	2	0.05	0.39

Note. $n = 39$ for all variables. Each shift was analyzed for 39 consecutives days, 21 January through 28 February 2007.

[a]The total equals the total variance between the WMSN recommended number of RNs and the number of RNs that worked during the analyzed timeframe.

Appendix G

Descriptive Statistics for Work Shift Workload and RN Experience

	Wkld			RNexp		
Unit shift	Total[a]	*M*	*SD*	Total[b]	*M*	*SD*
Surg						
Day	355	9.10	4.81	3300	84.62	27.72
Evening	81	2.08	2.78	2615	67.05	26.80
Night	61	1.56	3.23	2379	61.00	26.20
MBU						
Day	768	19.69	6.02	2304	59.08	30.32
Evening	342	8.77	6.75	1454	37.28	14.09
Night	241	6.18	3.94	1067	27.36	16.00
Med						
Day	241	6.18	2.70	1108	28.41	11.76
Evening	187	4.79	3.88	747	19.15	5.23
Night	102	2.62	2.30	984	25.23	4.56
Psych						
Day	43	1.10	1.27	1508	38.67	20.77
Evening	20	0.51	0.68	1306.50	33.50	15.57
Night	6	0.15	0.37	970	24.87	9.48

	Wkld			RNexp		
Unit shift	Total[a]	*M*	*SD*	Total[b]	*M*	*SD*
ICU						
Day	58	1.49	1.43	4124	105.74	30.06
Evening	47	1.21	1.51	1925	49.36	10.36
Night	20	0.51	0.68	699	17.92	8.60
NICU						
Day	123	3.15	2.54	1726	44.26	16.48
Evening	61	1.56	1.52	1740	44.62	9.66
Night	50	1.28	1.93	2533	64.95	16.73
Peds						
Day	67	1.72	1.36	1395	35.77	18.66
Evening	78	2.00	1.78	716	18.36	11.65
Night	17	0.44	0.75	1510	38.72	19.63

Note. $n = 39$ for all variables. Each shift was analyzed for 39 consecutives days, 21 January through 28 February 2007.

[a]The Wkld total equals the total number of patient admissions, discharges, transfers in, and transfers out that occurred during the analyzed timeframe. [b]The RNexp total equals the cumulative number of years experience for the RNs that worked during the analyzed timeframe.

Appendix H

Individual RN Experience Levels for each Inpatient Unit

Unit	*M*	*SD*	Low[a]	High[b]	*N*[c]
Surg	14.42	13.58	1	44	26
MBU	9.75	6.11	2	22	24
Med	5.78	3.92	1	18	23
Psych	19.44	9.67	6	39	9
ICU	16.13	8.72	6	35	16
NICU	14.16	6.44	3	28	19
Peds	19.71	18.70	1	50	7

[a]Low equals the number of years experience for the nurse with the least years nursing experience. [b]High equals the number of years experience for the nurse with the greatest years nursing experience. [c]*N* equals the number of RNs that worked on the unit during the analyzed time frame, 21 January through 28 February 2007.

Appendix I

Descriptive Statistics for Observation Patients, Recovery Patients, and Outpatient Procedures

	Obsvpt			Rcvery			Outptproc		
Unit shift	Total[a]	*M*	*SD*	Total[b]	*M*	*SD*	Total[c]	*M*	*SD*
Surg	147	1.26	1.60	–	–	–	–	–	–
Med	21	0.18	0.39	–	–	–	–	–	–
ICU	–	–	–	55	0.47	0.88	–	–	–
Peds	19	0.16	0.37	–	–	–	60	0.51	1.62

Note. $n = 117$ for all variables.

[a]The observation patient total equals the total number of observation patients during the analyzed timeframe; thus, one patient may be counted three times if that patient was present over three consecutive shifts. [b]The recovery patient total equals the total number of recovery patients during the analyzed timeframe. [c]The outpatient procedure total equals the total number of outpatient procedures performed during the analyzed timeframe.

Appendix J

Variables in svsurg Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-0.76	0.59	-1.29	.19	–
wkld	0.09	0.05	1.82	.07	0.99
RNexp	0.02	0.01	2.14	.03	1.02
obsvpt	-0.12	0.13	-0.96	.34	0.89

Note. $n = 117$. $G\ (3, n = 117) = 14.54, p < .00$. Deviance $(110, n = 117) = 135.45, p = .05$.

Appendix K

Variables in svmom Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-1.67	0.47	-3.52	.00	–
wkld	-0.04	0.03	-1.42	.15	0.96
RNexp	0.04	0.01	4.23	.00	1.05

Note. $n = 117$. $G\ (2, n = 117) = 24.78, p < .00$. Deviance $(111, n = 117) = 126.62, p = .15$.

Appendix L

Variables in svmed Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-0.88	0.65	-1.36	.17	–
wkld	-0.20	0.07	-2.99	.00	0.81
RNexp	0.06	0.02	2.51	.01	1.06
obsvpt	0.07	0.53	0.14	.89	1.08

Note. $n = 117$. $G\,(3, n = 117) = 16.64$, $p < .00$. Deviance $(96, n = 117) = 124.22$, $p = .02$.

Appendix M

Variables in svpsych Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-6.17	1.22	-5.05	.00	–
wkld	0.35	0.31	1.15	.25	1.43
RNexp	0.08	0.02	3.82	.00	1.08

Note. $n = 117$. $G\,(2, n = 117) = 20.36$, $p < .00$. Deviance $(65, n = 117) = 40.37$, $p = .99$.

Appendix N

Variables in svicu Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-1.67	0.44	-3.82	.00	–
wkld	0.01	0.18	-0.08	.94	0.99
RNexp	0.03	0.01	4.53	.00	1.03
rcvery	-0.54	0.26	-2.08	.04	0.58

Note. $n = 117$. $G\,(3, n = 117) = 39.10, p < .00$. Deviance $(96, n = 117) = 105.20, p = .24$.

Appendix O

Variables in svnicu Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	0.32	0.64	0.50	.62	–
wkld	0.01	0.09	0.10	.92	1.01
RNexp	-0.01	0.01	-1.23	.22	0.99

Note. $n = 117$. $G\ (2, n = 117) = 1.62, p = .44$. Deviance $(89, n = 117) = 118.65, p = .02$.

Appendix P

Variables in svpeds Equation

Predictor	Coefficient	*SE* Coefficient	z	*p*	Odds Ratio
Constant	-4.89	1.17	-4.18	.00	–
wkld	0.74	0.22	3.37	.00	2.10
RNexp	0.04	0.02	1.83	.07	1.04
obsvpt	-0.70	0.99	-0.70	.48	0.50
outptproc	0.07	0.21	0.32	.75	1.07

Note. $n = 117$. $G\ (4, n = 117) = 14.24, p < .00$. Deviance $(71, n = 117) = 53.77, p = .93$.

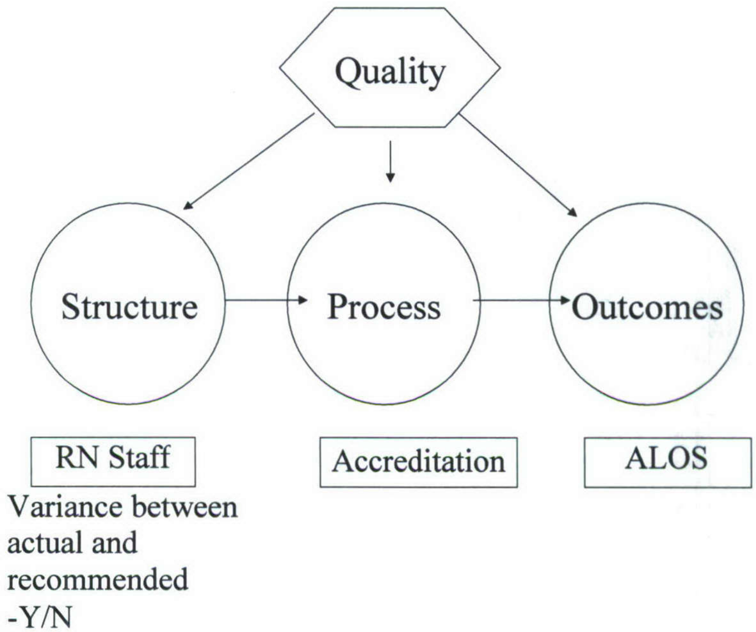
Appendix Q

Figures

Figure Captions

Figure Q1. Conceptual model.

Figure Q2. Research process.


Quality
Structure
Process
Outcomes
RN Staff
Variance between
actual and
recommended
-Y/N
Accreditation
ALOS

Explanatory Study:
Why do registered nursing staff variances exist between the WMSN recommended RN staffing and the RN staffing at WAMC?

Nursing 24-hour reports, surgical staffing schedule, and manual data retrieval for all WAMC inpatient nursing units for a 39-day period

Variables:
DV: RN Staffing Variance
IV: Changes in Workload
Staff Mix Variances
Staff Experience
Observation Patients
Patient Mix
Recovery Patients
Outpatient Procedures

Statistics:
Descriptives
Logistic Regression